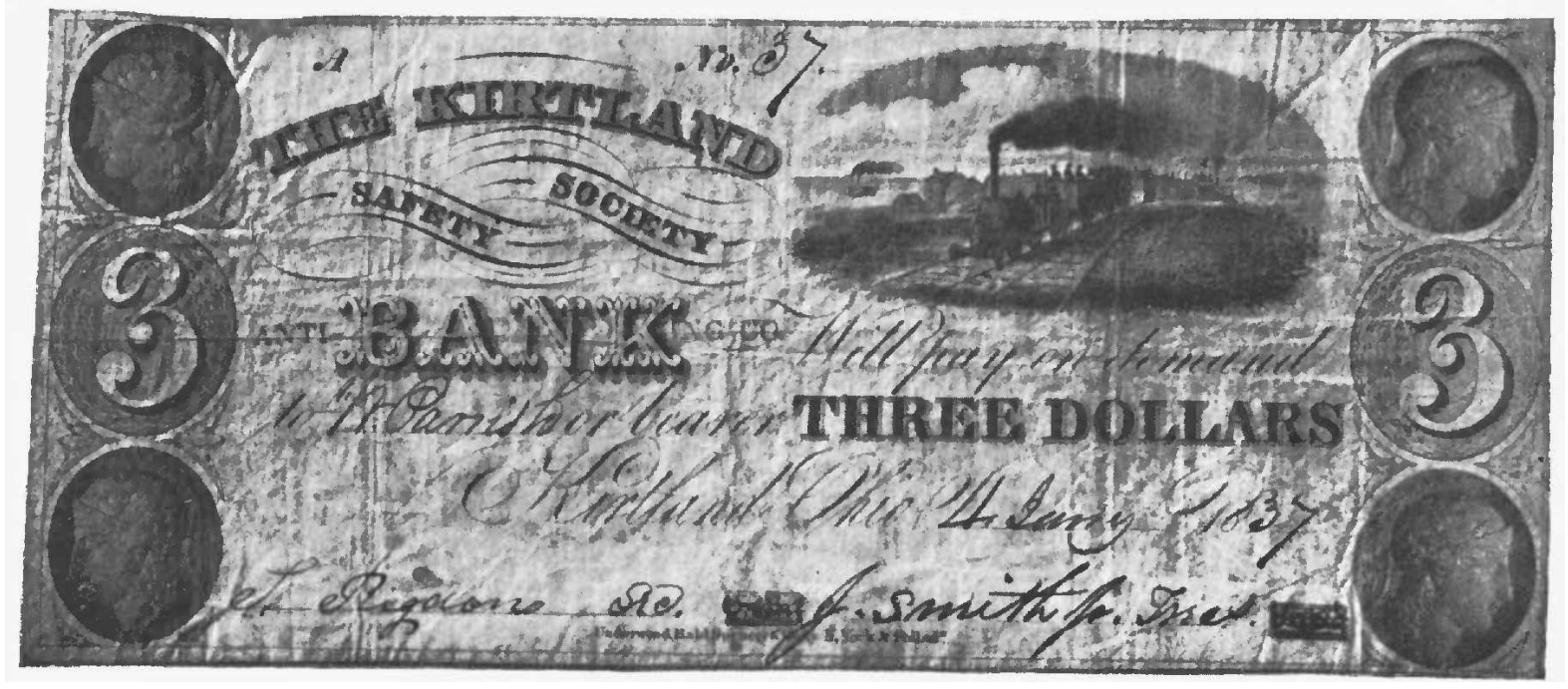
MONEY RUNS

Jason Roderick Donaldson
Wash U

Giorgia Piacentino
Columbia & CEPR


No. 37.
THE KIRTLAND
SAFETY SOCIETY
BANK
THREE DOLLARS
3
3

FACTS

In 19th century, most money was private bank debt—banknotes

Banknotes were tradeable OTC

To get beer from barman, passed banknotes over the counter

Banknotes were fragile means of payment

"Note that passed freely yesterday rejected this morning"

Banknotes were redeemable on demand, exposing banks to runs

Bank runs followed failure banknotes to circulate

QUESTIONS

Why is it optimal for banks to issue demandable debt?

Especially since exposes them to sudden redemptions—runs

Why redeem instead of trade?

QUESTIONS

Why is it optimal for banks to issue demandable debt?

Especially since exposes them to sudden redemptions—runs

Why redeem instead of trade?

New rationale for demandable debt and new type of run

THIS PAPER

Model how banks create money given two assumptions

Assumption 1: Horizon mismatch

Creditors may need liquidity before investment payoff

Assumption 2: Decentralized trade

Bank debt traded bilaterally OTC in secondary market

MODEL

MODEL OVERVIEW

Discrete time infinite horizon $t \in \{0, 1, 2, ...\}$, no discounting

Two types of risk-neutral player: borrower B, creditors C_0, C_1, ...

B has investment, creditors have wealth

BORROWER B

B is penniless but has a positive NPV investment

Costs c and pays off y at random maturity, arrival rate ρ

$$\text{NPV} = y - c > 0$$

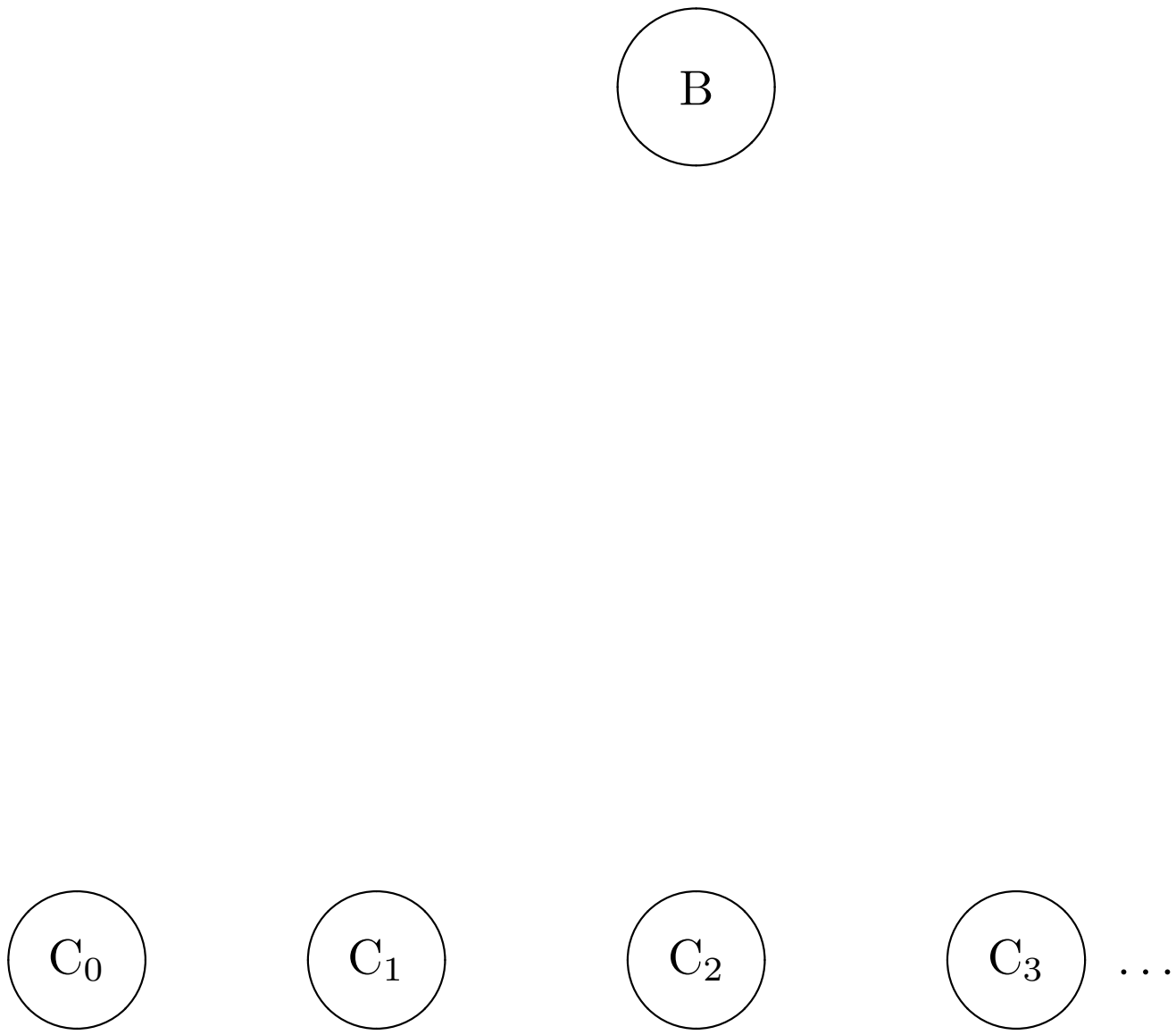
Can be liquidated early for $\ell < c/2$

CREDITORS C_0, C_1,...

Deep-pocketed

Liquidity shock at random time, arrival rate θ

PLAYERS



BORROWING INSTRUMENTS

B borrows c via debt with face value $R \leq y$ at maturity

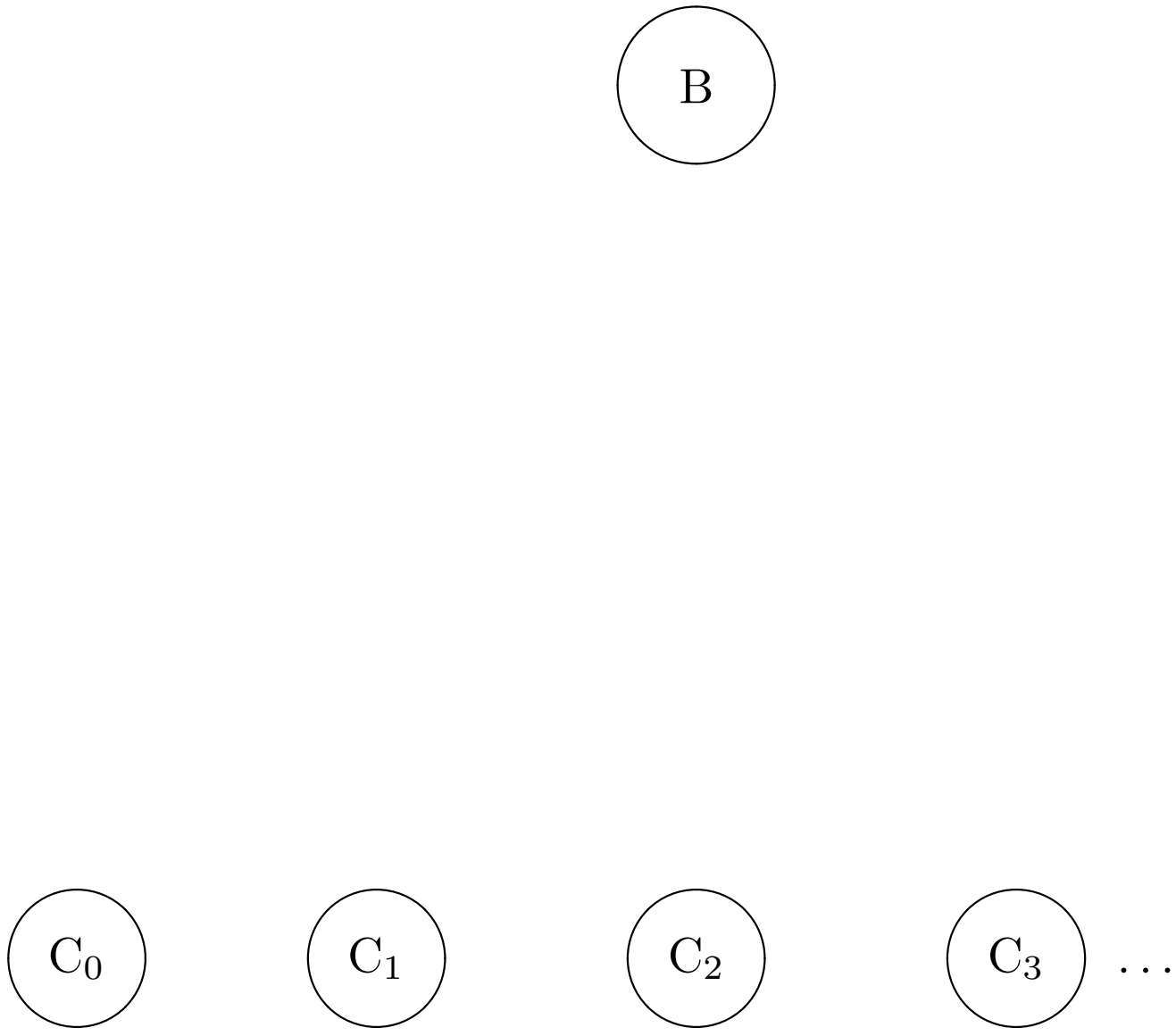
Long term or demandable

Tradeable or non-tradeable

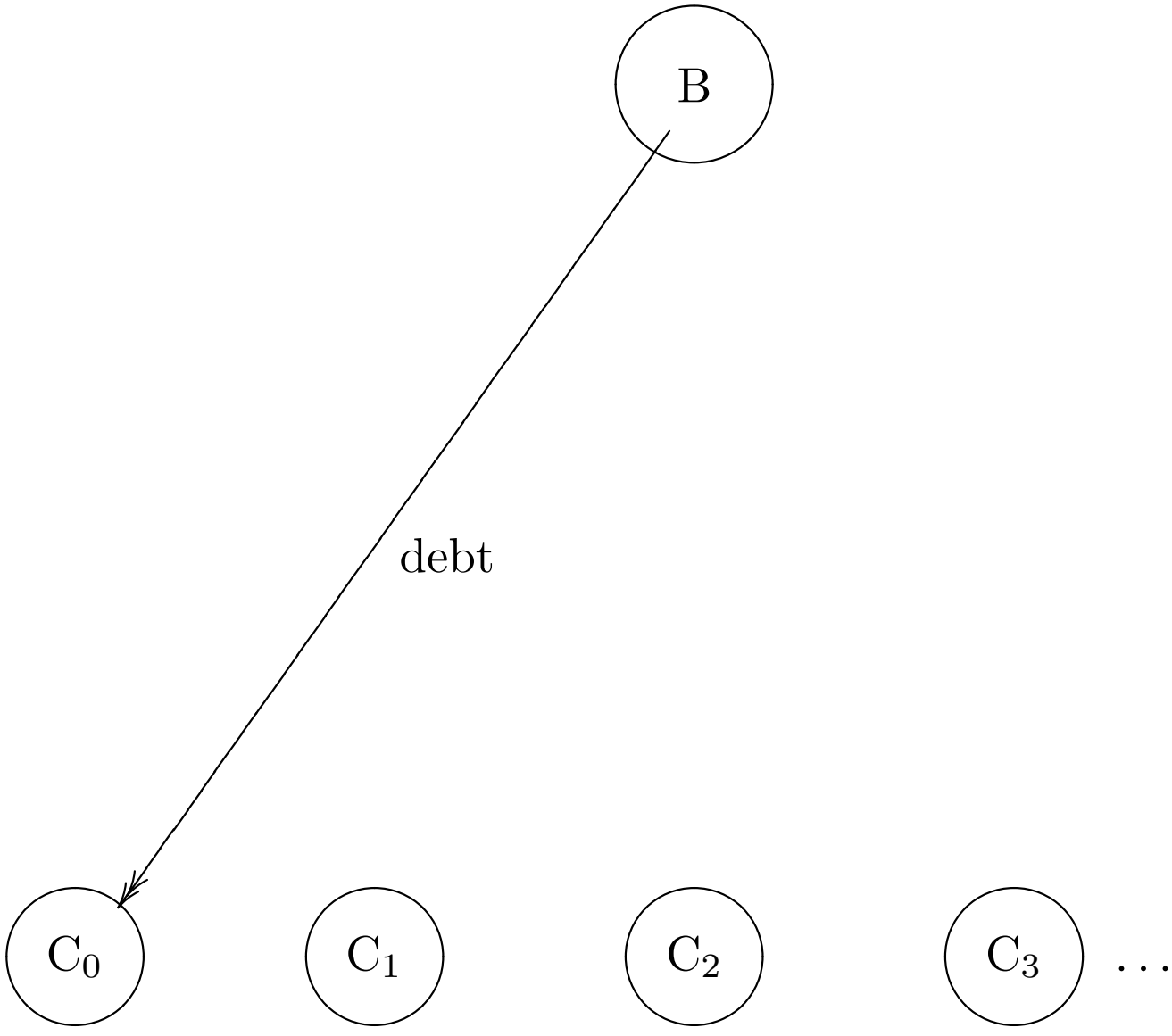
v_t denotes value of debt to not-shocked creditor

p_t denotes its secondary market price

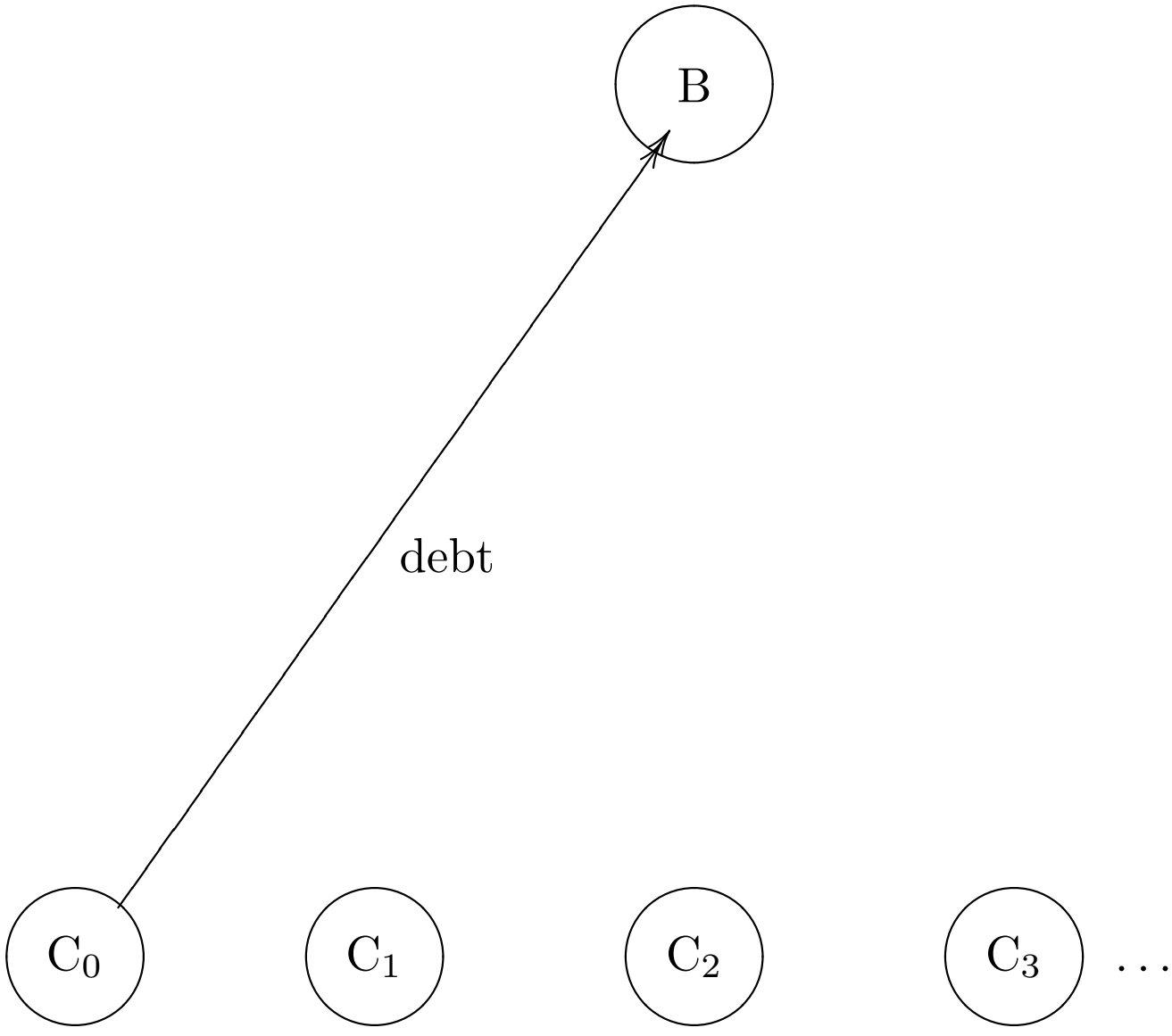
DEMANDABLE DEBT



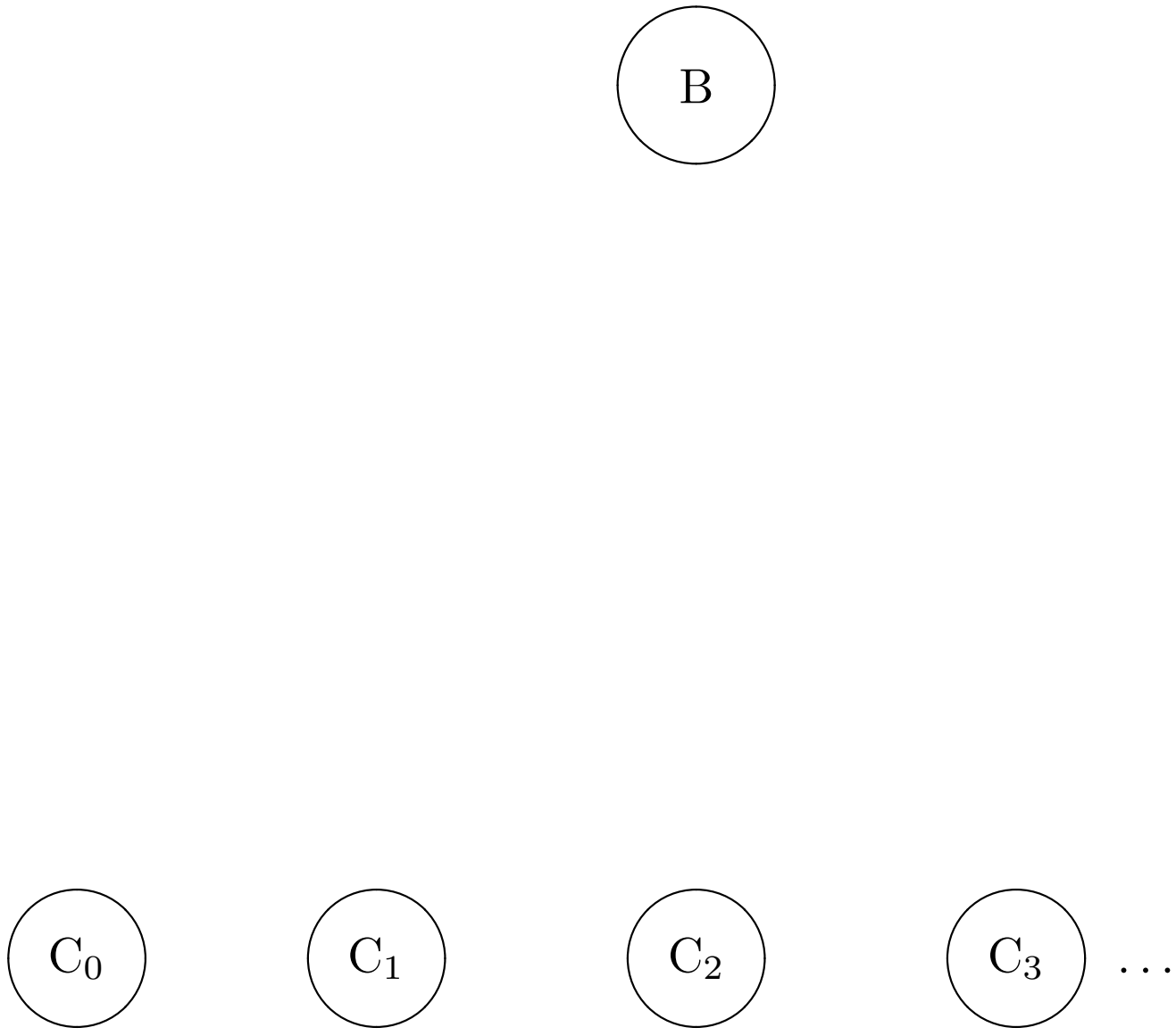
DEMANDABLE DEBT



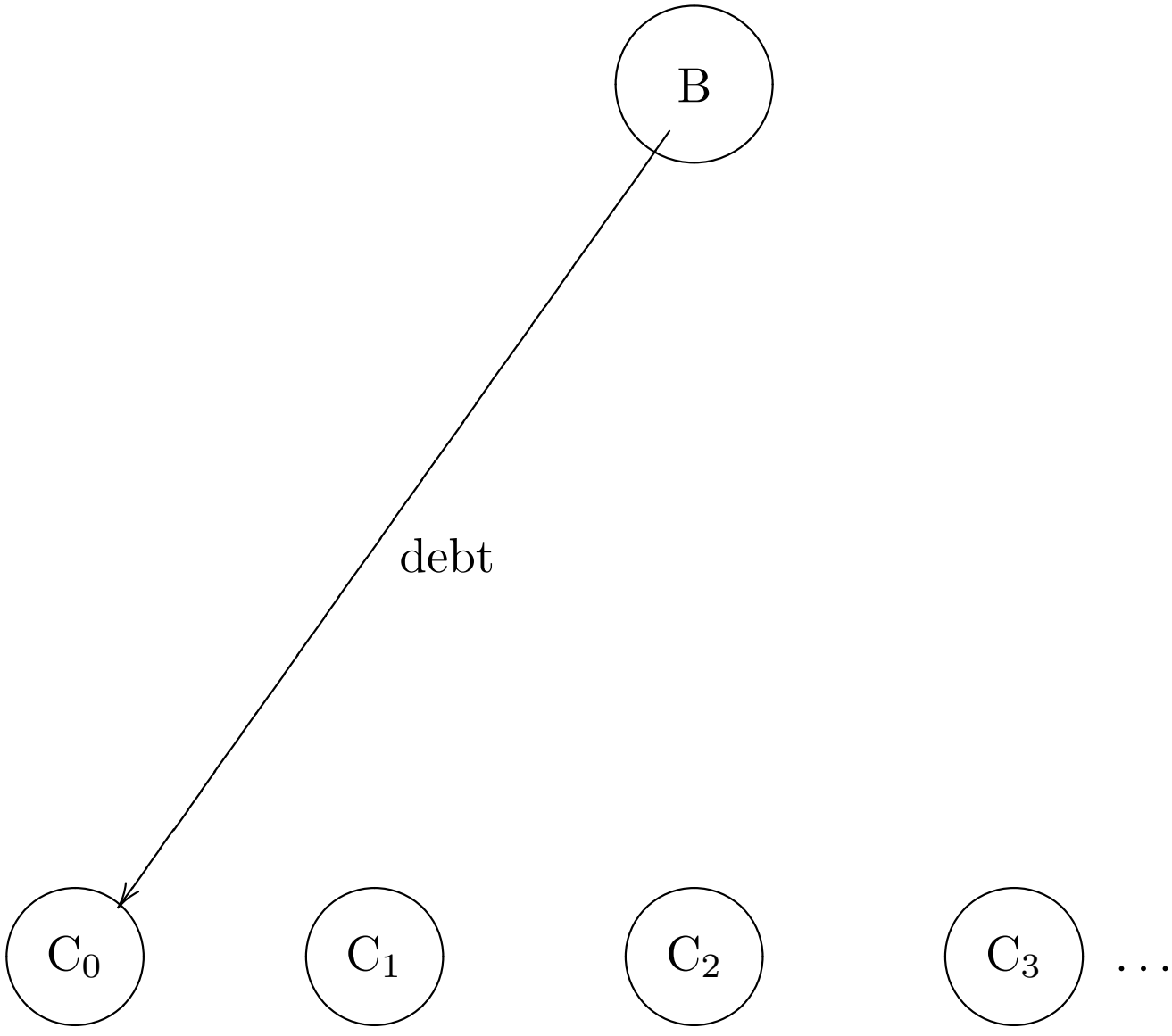
DEMANDABLE DEBT



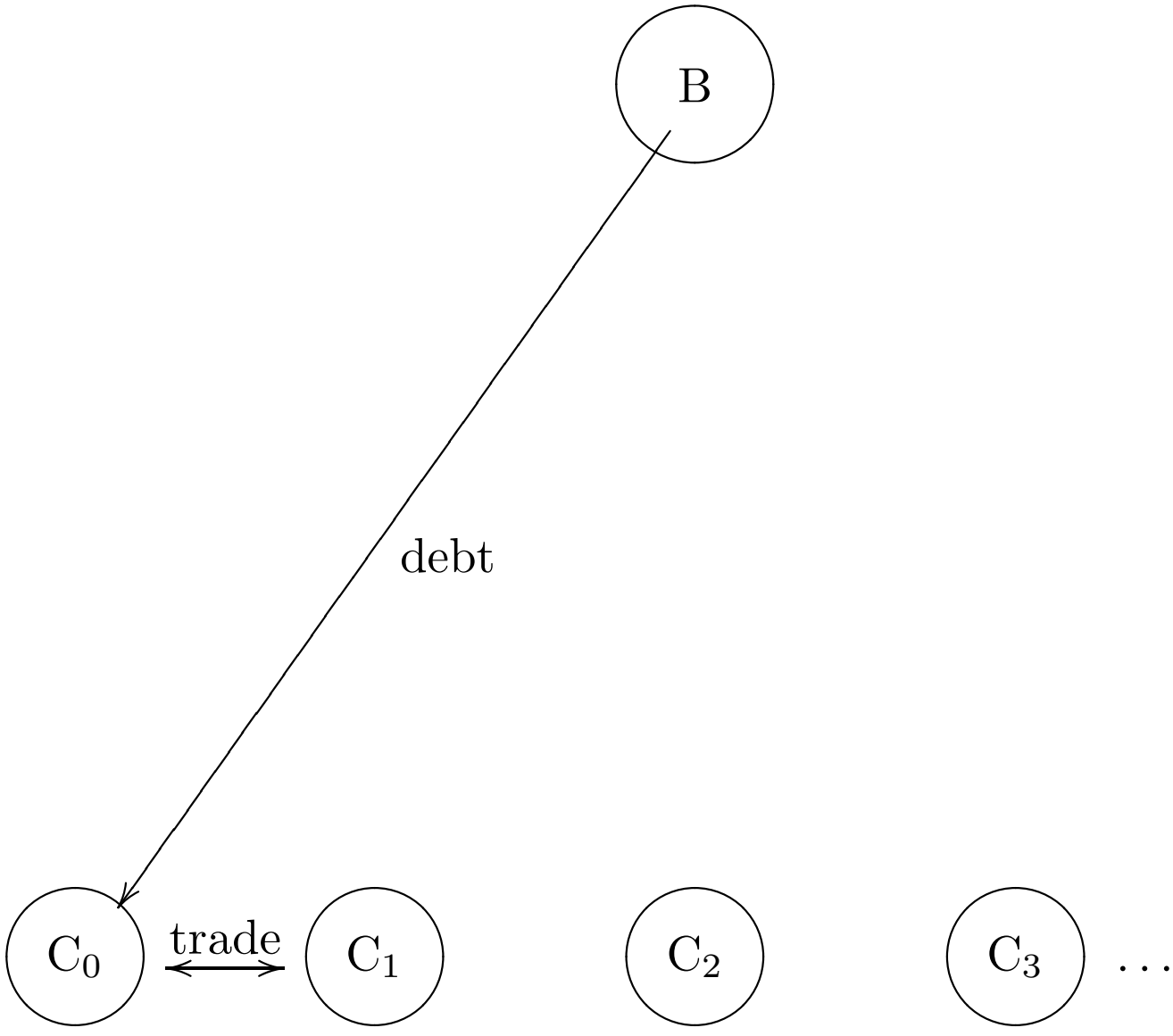
TRADEABLE DEBT



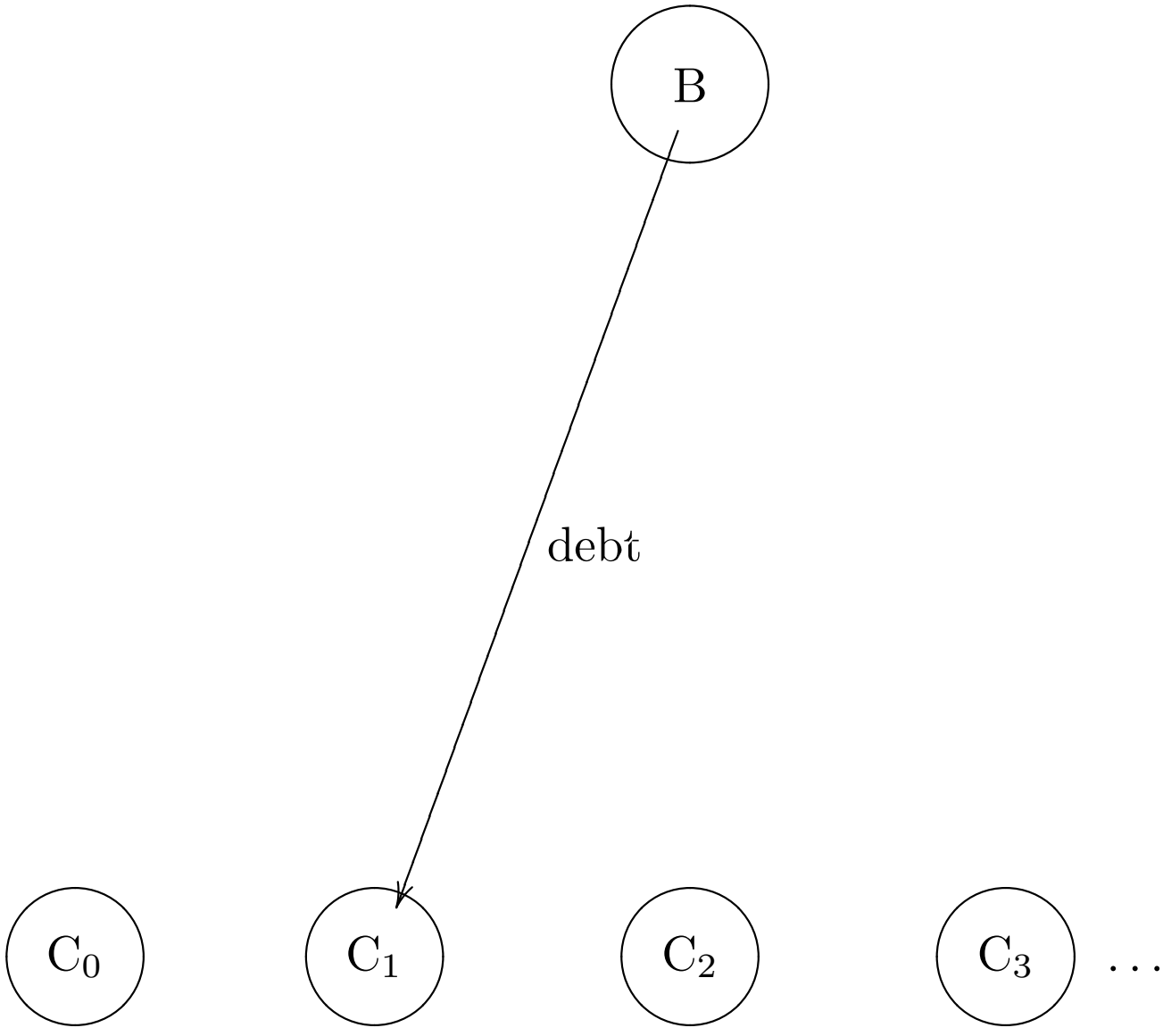
TRADEABLE DEBT



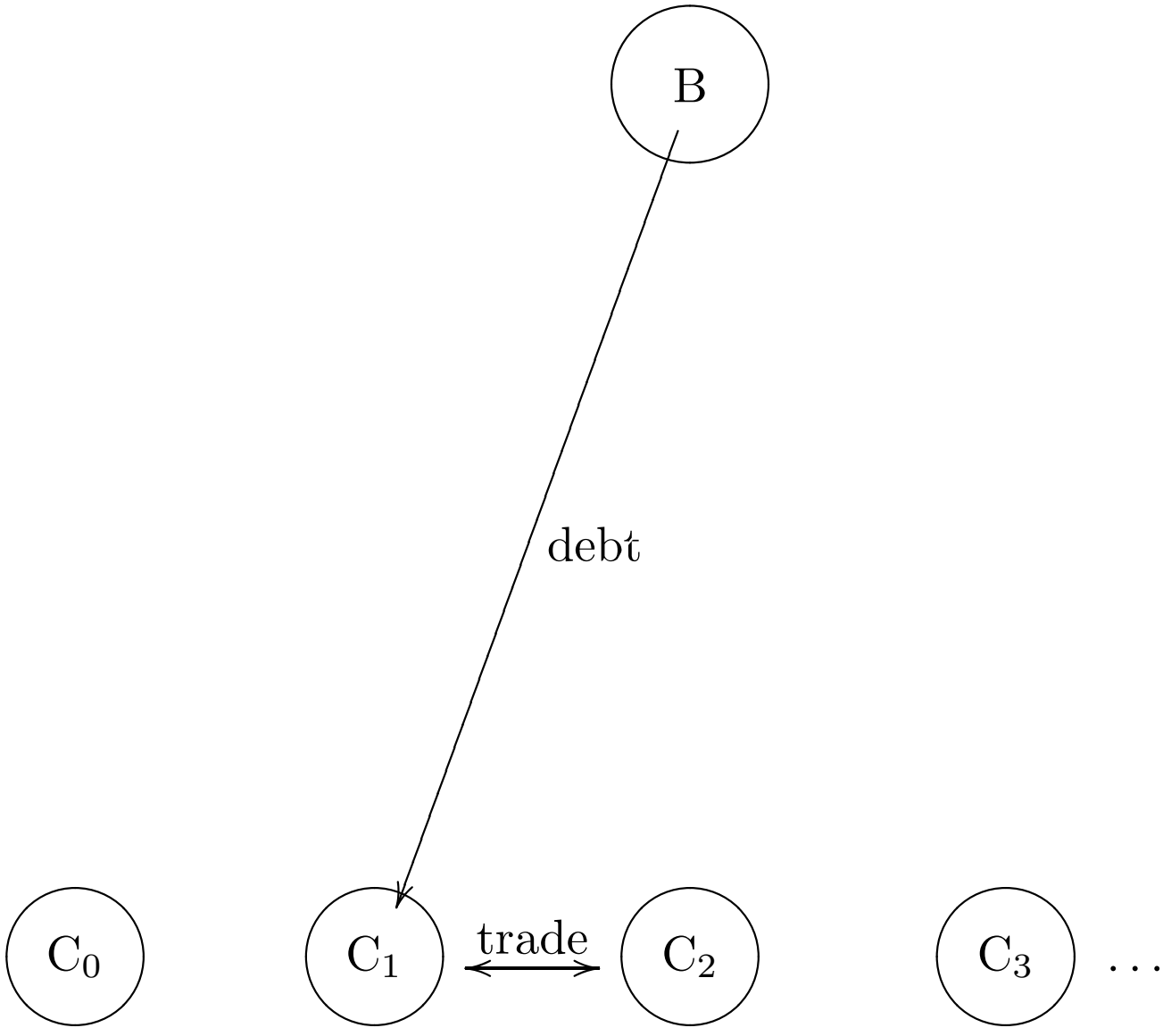
TRADEABLE DEBT



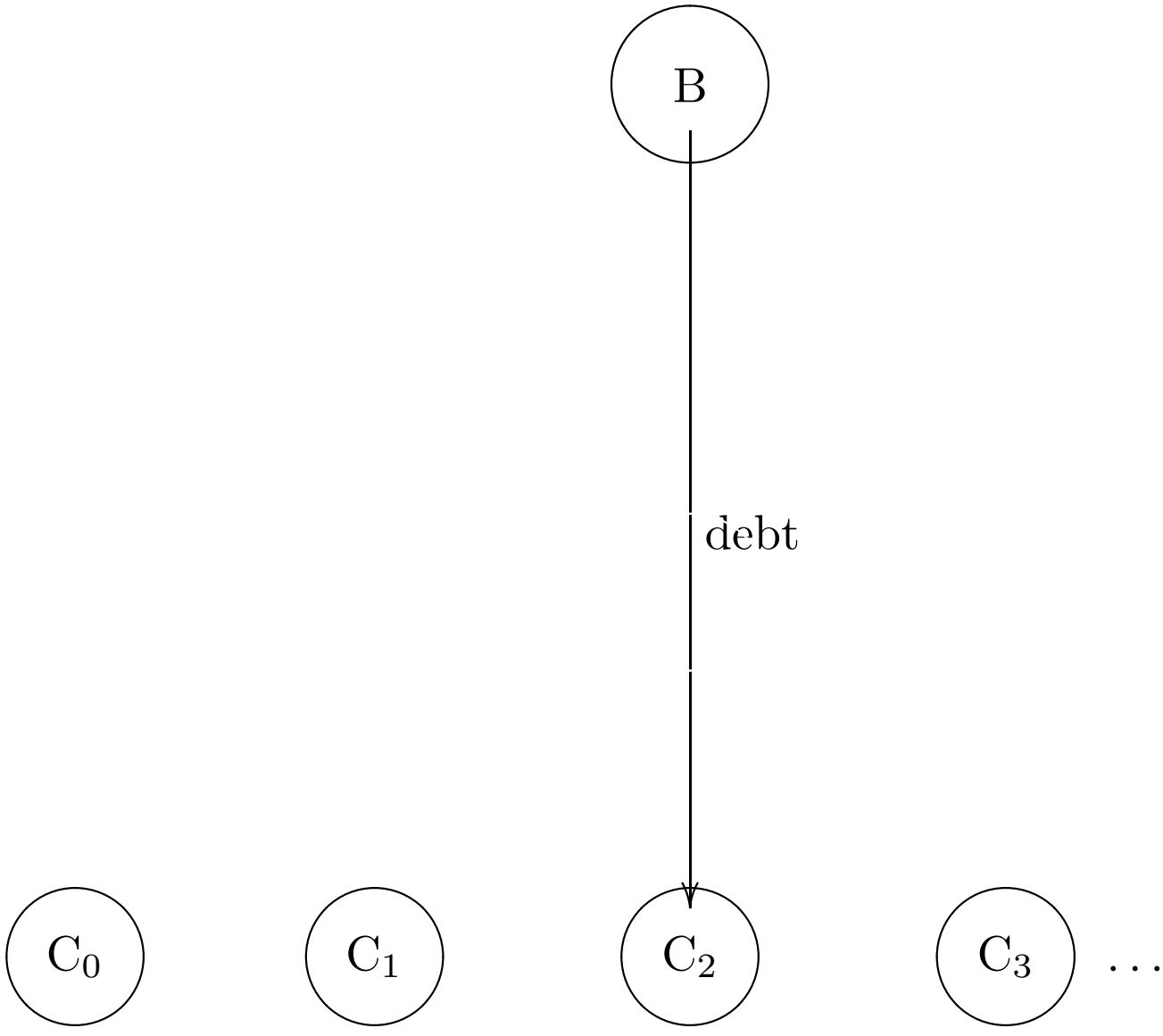
TRADEABLE DEBT



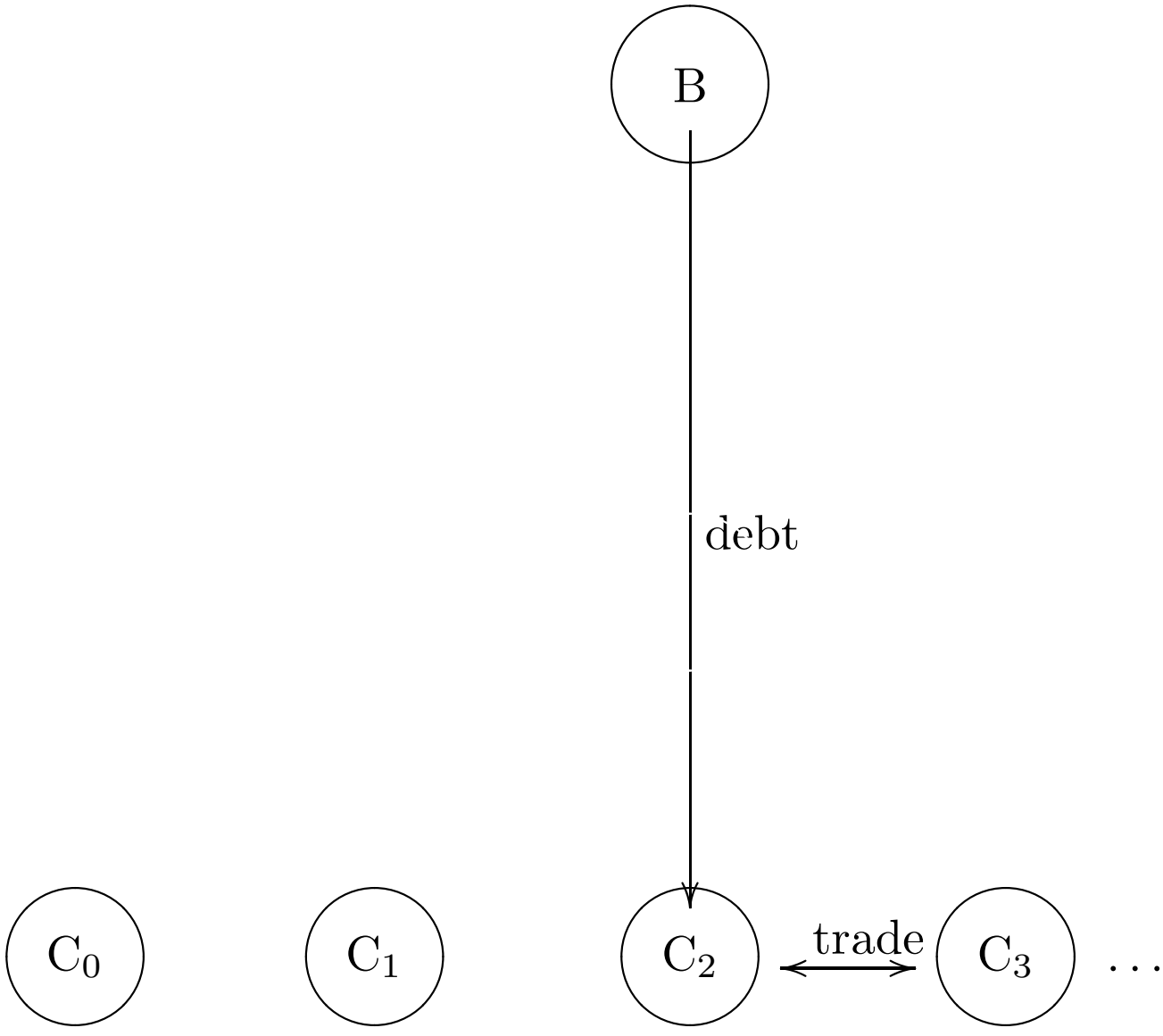
TRADEABLE DEBT



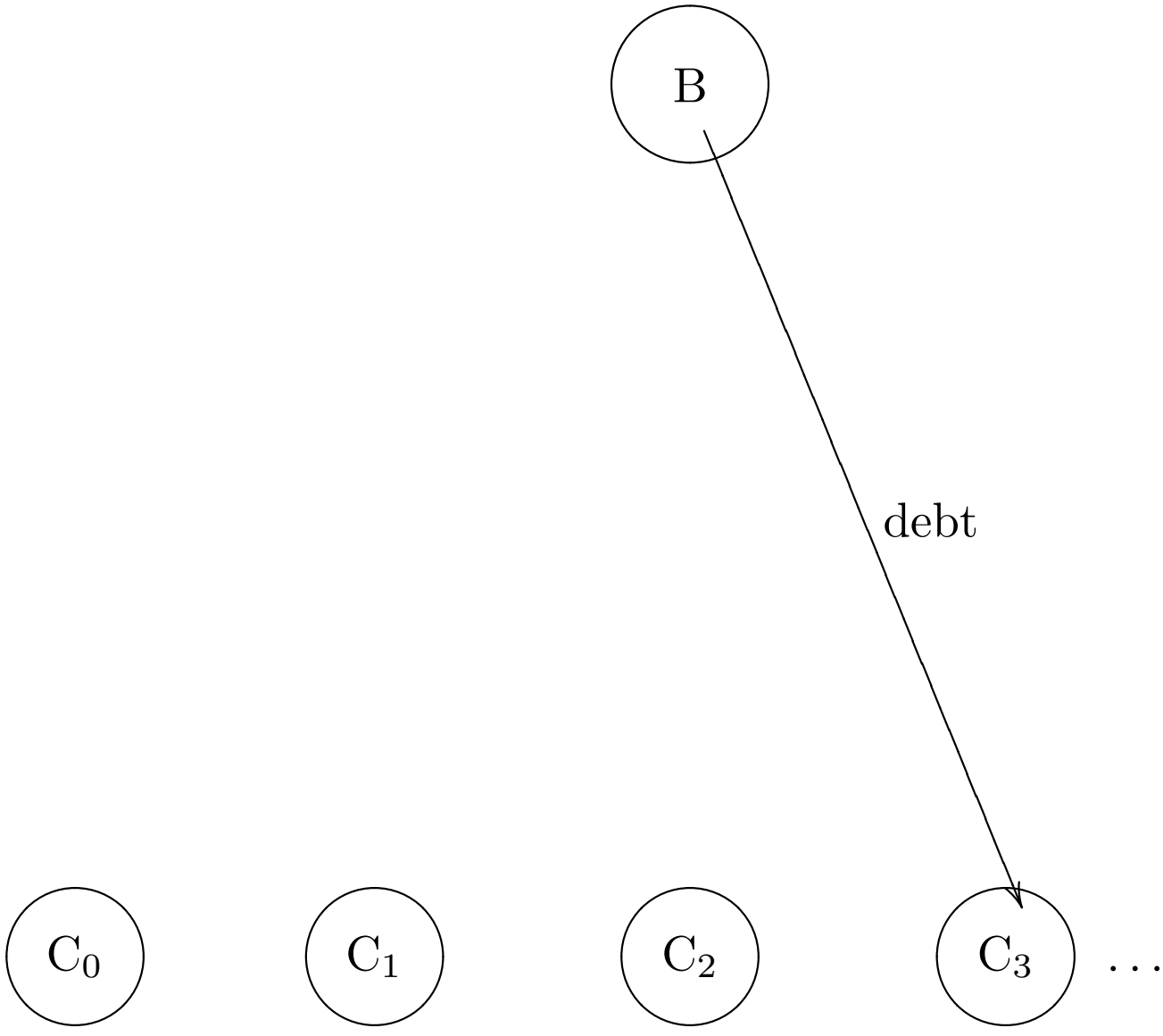
TRADEABLE DEBT



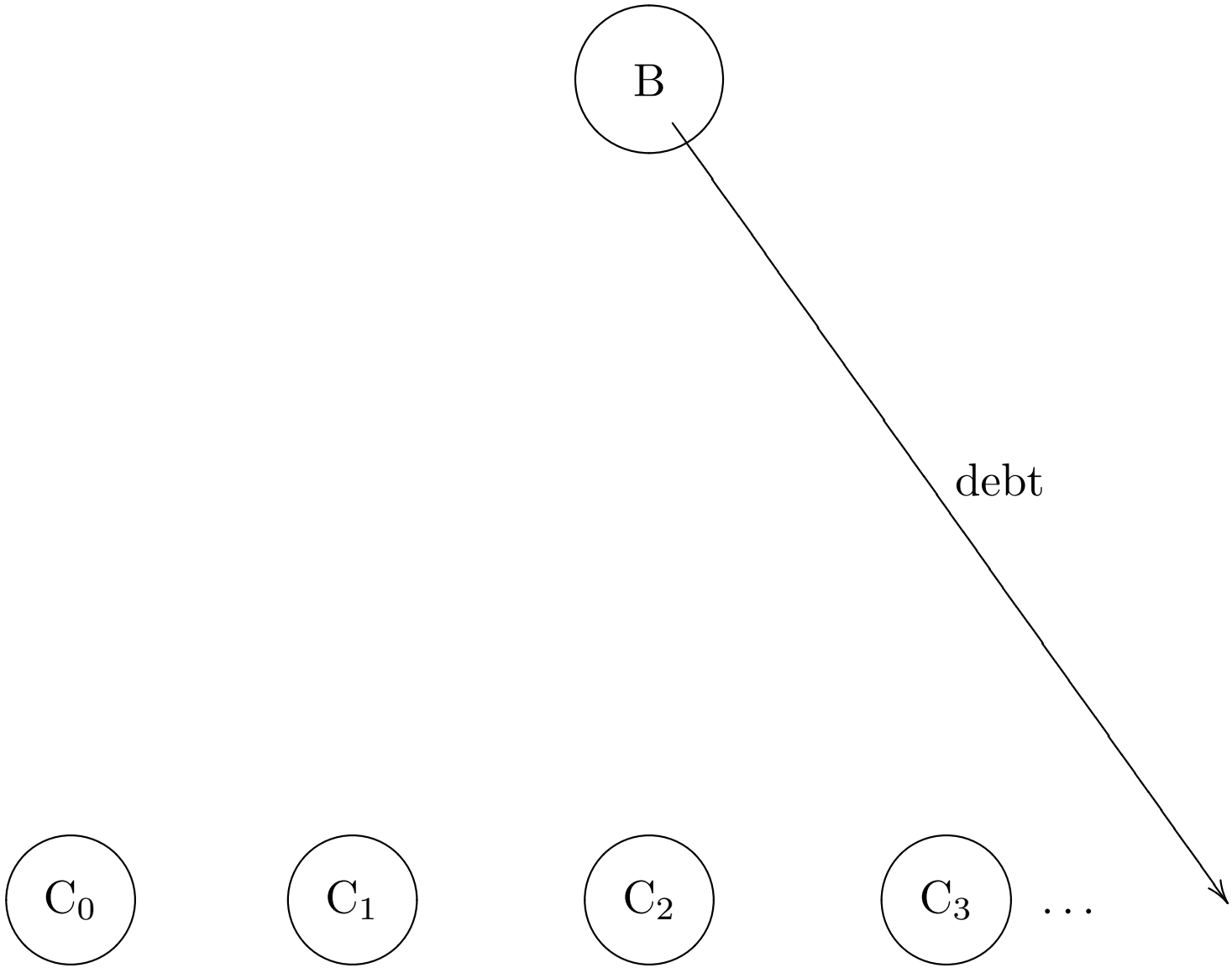
TRADEABLE DEBT



TRADEABLE DEBT



TRADEABLE DEBT



TIMELINE

Date 0

B borrows from C_0 and invests or does not

Date $t > 0$: if B's investment pays off

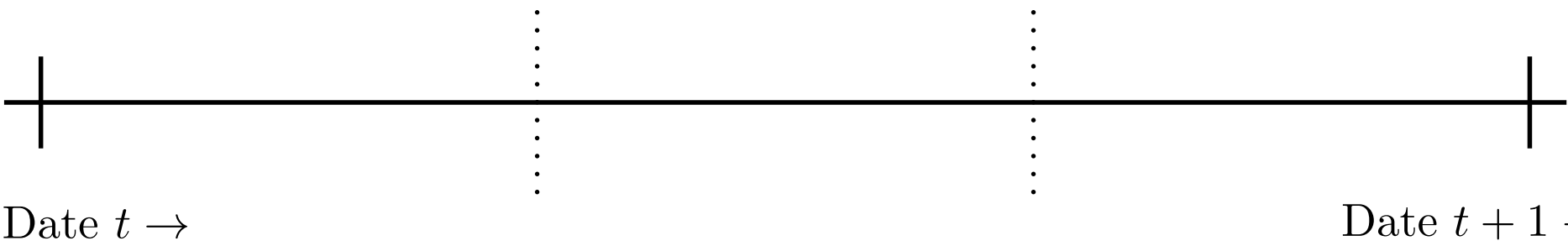
B repays R

Date $t > 0$: if B's investment does not pay off

Secondary debt market entry, bargaining, settlement

TRADEABILITY AND DEMANDABILITY

Entry	Bargaining	Settlement
counterparty C_t	debtholder and C_t	debt traded
can enter at cost k	determine price p_t	or demanded
	50-50 Nash bargaining	



HORIZON MISMATCH ASSUMPTION ($\star$)

Horizon mismatch sufficiently severe

I.e. investment horizon $1/\rho$ large, liquidity horizon $1/\theta$ small:

$$\frac{1}{\rho} > \frac{1}{\theta} \cdot \frac{2\big(y-c\big)}{c(1-\rho)} \qquad (\star)$$

($\star$) gives role for maturity transformation, so B is like a bank

HORIZON MISMATCH AS INVESTMENT BOUND

($\star$) can be rewritten as a lower bound on c

$$c > c^\star := \frac{\rho y}{\rho + (1-\rho)\theta/2} \qquad (\star)$$

EQUILIBRIUM CONCEPT

Subgame perfect equilibrium

At Date 0, C_0 lends to B or does not

At Date $t > 0$, C_t enters with probability σ_t

σ_t is C_t's best response to others' strategies $\sigma_{\neg t}$

R and p_t outcomes of Nash bargaining

(Assume wlog C_t can enter iff debtholder has liquidity shock)

RESULTS

POSSIBLE INSTRUMENTS

	long-term	demandable
non-tradeable	“loan”	“puttable loan”
tradeable	“bond”	“banknote”

RULING OUT INSTRUMENTS

Consider each instrument in turn and see if B can borrow

B can borrow iff $v_0 \geq c$

$c > c^\star$ by $(\star)$, so can borrow only if $v_0 > c^\star$

LOAN

LOAN (NON-TRADEABLE LONG-TERM DEBT)

Value v_t of loan solves

$$v_t = \rho R + (1-\rho)\Big(\theta \times 0 + (1-\theta)v_{t+1}\Big)$$

C_0 thus lends if

$$c \leq v = \frac{\rho R}{\rho + (1-\rho)\theta}$$

But $v < c^\star$, violating $(\star)$: B cannot raise funds with loan

LOAN (NON-TRADEABLE LONG-TERM DEBT)

Value v of loan solves

$$v = \rho R + (1-\rho)\Big(\theta \times 0 + (1-\theta)v\Big)$$

C_0 thus lends if

$$c \leq v = \frac{\rho R}{\rho + (1-\rho)\theta}$$

But $v < c^\star$, violating $(\star)$: B cannot raise funds with loan

PUTTABLE LOAN

PUTTABLE (NON-TRADEABLE DEMANDABLE)

Value v of puttable loan solves

$$v = \rho R + (1-\rho)\Big(\theta\ell + (1-\theta)v\Big)$$

C_0 thus lends if

$$c \leq v = \frac{\rho R + (1-\rho)\theta\ell}{\rho + (1-\rho)\theta}$$

But $v < c^\star$, violating $(\star)$: B cannot raise funds with puttable loan

BOND

BOND (TRADEABLE LONG-TERM DEBT)

Bond traded OTC, price p_t determined by 50-50 Nash bargaining

Debtholder bargains with C_t to get

$$p_t = \text{ outside option } + \frac{1}{2} \times \text{ gains from trade}$$

Outside option zero (not demandable)

Gains from trade v_t

Thus $p_t = v_t/2$

BOND VALUE

Value v of bond solves

$$v = \rho R + (1-\rho)\Big(\theta\Big(\sigma p + (1-\sigma)\times 0\Big) + (1-\theta)v\Big)$$

Suppose bond circulates or $\sigma = 1$ (best-case scenario)

C_0 thus lends if

$$c \leq v = \frac{\rho R}{\rho + (1-\rho)\theta/2}$$

But $v < c^\star$, violating $(\star)$: B cannot raise funds with bond

BANKNOTE

BANKNOTE (TRADEABLE DEMANDABLE) PRICE

Banknote traded OTC, price p_t determined by Nash bargaining

Debtholder bargains with C_t to get

$$p_t = \text{ outside option } + \frac{1}{2} \times \text{ gains from trade}$$

Outside option ℓ (demandable)

Gains from trade $v_t - \ell$

Thus $p_t = \ell + \frac{1}{2}(v_t - \ell) = \frac{v_t + \ell}{2}$

BANKNOTE VALUE

Value v of banknote solves

$$v = \rho R + (1-\rho)\Big(\theta\Big(\sigma p + (1-\sigma)\ell\Big) + (1-\theta)v\Big)$$

Suppose banknote circulates or $\sigma = 1$ (best case scenario)

C_0 thus lends if

$$c \leq v = \frac{\rho R + (1-\rho)\theta\ell/2}{\rho + (1-\rho)\theta/2}$$

$v > c^\star$, feasible! B may be able to raise funds with banknote

NEW RATIONALE FOR DEMANDABLE DEBT

Demandable debt increases secondary market price

Improves bargaining position of debtholder

Demandable debt increases primary market price

Higher secondary price leads to higher primary price

Demandable debt increases B's debt capacity

DEMANDABLE DEBT HAS A DARK SIDE

If C_t doubts future liquidity, won't enter

Debtholder needs liquidity but can't trade in secondary market

Debtholder redeems note on demand, B must liquidate

Bank run—or money run

MONEY RUNS AS MULTIPLE EQUILIBRIA

Money runs whenever multiple equilibria in secondary market

I.e. σ is best-response to σ for both $\sigma = 0$ and $\sigma = 1$

$$v - p\Big|_{\sigma=0} \;<\; k \;<\; v - p\Big|_{\sigma=1}$$

or

$$\frac{\rho(R-\ell)}{2\big(\rho + (1-\rho)\theta\big)} \;<\; k \;<\; \frac{\rho(R-\ell)}{2\rho + (1-\rho)\theta}$$

MONEY RUNS ARE NECESSARY EVIL

Must borrow via demandable debt to fund investment

Necessarily exposed to money runs

DEMANDABILITY AND TRADEABILITY

Jacklin (1987) says demandability and tradeability are substitutes

- You don't need option to demand debt if can trade it
- Tradeable debt gets efficiency without risk of runs

We say demandability and tradeability are complements

- Your option to demand debt increases the price you trade at
- Need demandable debt for efficiency despite risk of runs

MONEY RUN VS DIAMOND-DYBVIG RUN

Money run

- Dynamic coordination problem in secondary market
- "Self-fulfilling liquidity dry-up" leads to redemption

Diamond-Dybvig run

- Static coordination problem among depositors

EMPIRICAL CONTENT

REPOS—CONTEMPORARY PRIVATE MONEY

Repos analog of banknotes—demandable and tradeable

Form of money counted in M3

Demandable: positions left open unless "withdrawal"

Unlike e.g. commercial paper, closed and re-opened

Tradeable: "spend" repos by rehypothecating collateral

> "collateral can be 'spent'—used as collateral in another, unrelated, transaction.... Same collateral can support multiple transactions, just as one dollar of cash can. The collateral is functioning like cash."
>
> —Gorton and Metrick (2010)

RUNS ON BACKED ASSETS

19th century banknotes (and repos today) backed by collateral

> In the case of a bank failure...state bonds would be sold (by the state government) and the note holders paid off pro rata
>
> So, strategic considerations about coordinating with other agents do not arise.... Yet there was a run
>
> This is a challenge for theory and raises issues concerning notions of liquidity and collateral, and generally of the design of trading securities—private money
>
> —Gorton (2012)

EMPIRICAL CONTENT

Explanation for why bank debt both run-prone and demandable

Also casts light on a number of other stylized facts:

(i) Demandable debt likely medium of exchange

(ii) Bank debt more likely to be demandable than corporate debt

(iii) 19th-century banknotes often traded at a discount

Discounts increased with distance from issuer

(iv) Debt runs occur in isolation (typically are not market-wide)

CONCLUSION

CONCLUSION

Focus on how banks create money—i.e. debt that circulates OTC

New reason why bank debt is demandable

- Props up price in secondary market
- Increases debt capacity in the primary market

New type of run

- Failure of circulation in secondary market
- Money run with one depositor

MONEY RUNS